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Environmental Cleanup Office

CHB

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July 10, 2000

Ms. Kristine A. Flint
Remedial Project Manager,
CB/NT Source Control
U.S. Environmental Protection Agency
Region 10
1200 6th Avenue, HW-113
Seattle, WA 98101-3188

Re: Source Control Status Report for the Head of Hylebos Waterway Problem Area, Milestone 5: Commencement Bay Nearshore/Tideflats Superfund Site

Dear Kris:

On behalf of Citizens for a Healthy Bay (CHB), an organization representing over 900 members of the Commencement Bay community, thank you for the opportunity to review the above referenced report prepared by the Washington State Department of Ecology. Based on our review of the NPDES permit files for ATOFINA (Elf Atochem North American, Inc.) and Kaiser Aluminum and Chemical Corporation, CHB has expressed several compliance and permit limit concerns to Ecology for both these firms.

ATOFINA (Elf Atochem) was found to have exceeded it limits for arsenic and chromium many times since 1998, with arsenic concentrations as high as 100 ug/L and chromium as high as 17 ug/L. Despite these problems, no enforcement actions are documented in Ecology's files. Antimony was not reported. The most recent draft permit proposed increasing the effluent concentration limit for arsenic to 100 ug/L and eliminate monitoring for chromium or antimony. ATOFINA discharges into Hylebos Waterway from Outfall 001 have repeated violated the chronic and marine water quality standards for arsenic of 36 ug/L and 69 ug/L. Additionally, flow and loading limits have not been imposed.

Kaiser Aluminum and Chemical Corporation routinely discharged up to 100 pounds of aluminum per day in violation of their maximum discharge limit of 50 pounds per day and repeated failed to sample three outfalls. Additionally, Ecology proposed to drop copper and nickel from the parameters to be monitored in connection to Kaiser's NPDES permit despite the fact that Kaiser has had a number of past compliance lapses for discharges of these chemicals.

The above examples highlight, what seems to CHB, a compromised strategy for controlling sources of problem chemicals into the head of Hylebos Waterway and we remain concerned that increased permit limits and lack of enforcement action for permit violations may well lead to long-term recontamination of the Hylebos Waterway.

A tax-exempt nonprofit organization with 501(c)(3) status

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Citizens for a Healthy Bay requests that our comments be added to the Administrative Record for the Hylebos Waterway Superfund Cleanup site.

Sincerely:

Leslie Ann Rose
Senior Policy Analyst
Citizens for a Healthy Bay

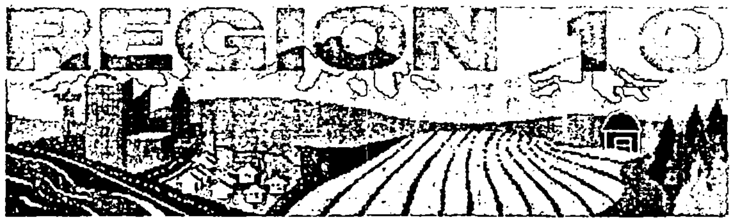
LR:lr

cc: Mr. Dave Smith, UBAT, Toxics Cleanup Program, Dept. of Ecology

Response Action Contract

Contract No. 68-W-98-228

EPA United States Environmental Protection Agency



Appendix to Ecology Milestones for Head of Hylebos Waterway

Technical Memorandum

Potential for Stormwater to Contaminate Sediments in the Head of Hylebos Waterway

August 1999

URS Greiner

in association with

CH2M HILL

White Shield, Inc.

APPENDIX TO ECOLOGY MILESTONES FOR HEAD OF HYLEBOS WATERWAY

TECHNICAL MEMORANDUM

POTENTIAL FOR STORMWATER TO CONTAMINATE SEDIMENTS IN THE HEAD OF THE HYLEBOS WATERWAY

TACOMA, WASHINGTON

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20 August 1999

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TECHNICAL MEMORANDUM

POTENTIAL FOR STORMWATER TO CONTAMINATE SEDIMENTS IN THE HEAD OF THE HYLEBOS WATERWAY

1. INTRODUCTION

As part of the source control investigations for the Commencement Bay Superfund site, the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology) identified potential or confirmed sources of problem chemicals in each of the waterways. Problem chemicals had been previously identified during the preliminary and main sediment quality surveys conducted during the remedial investigations. Fifteen sites were identified as actually or potentially having released contaminants to the upper Hylebos Waterway (from the middle turning basin and above; also referred to as the head of the Hylebos Waterway). Pathways for releases from these upland facilities included direct discharges, spills, improper disposal or landfilling of waste materials, discharge of contaminated groundwater, stormwater and waste water runoff, and erosion of contaminated soils. Remediation of the contaminated media at these upland facilities is ongoing and most of the cleanup actions are complete. Stormwater is defined as any surface water runoff from site that is collected and discharges into the waterway via a drainage pipe. This memorandum evaluates the potential for stormwater to recontaminate upper waterway sediments following remediation and is intended to serve as an appendix to Ecology's Milestone reports for the head of Hylebos Waterway. The potential for groundwater discharges to impact sediment quality is addressed in a separate memorandum.

The stormwater analysis relies upon recent data collected by or reported to Ecology to determine the potential impact to sediment quality. Only those data that were representative of post-cleanup stormwater that could discharge to the waterway were used (i.e., no pre-cleanup stormwater data were used).

2. APPROACH

Stormwater runoff is generated from rainfall. Contaminants in stormwater are carried as both particulate matter and dissolved load. A portion of the contaminant load is retained in the sediment, as a function of various chemical- and sediment-specific factors and duration.

A multi-step screening approach was used to evaluate potential contaminant loading to sediment from stormwater that discharges to the waterway. The specific screening approach used consisted of four steps that are outlined below. Loading was considered to be significant if it results in an exceedance of the sediment quality objectives (SQOs) specified in the Commencement Bay Record of Decision and the Explanation of Significant Difference (EPA 1997). The SQOs for selected contaminants are summarized in Table 1.

Step 1: Data Compilation

Existing environmental sampling data from 15 upland sites provided by Ecology were compiled. A description of environmental conditions and sampling results from these sites, primarily taken from the draft Milestone 3 and 4 reports (Ecology 1998a,b), is summarized in Table 2. Sites for which stormwater data were potentially available included:

- Kaiser Aluminum and Chemical Company (3400 Taylor Way) (stormwater commingled with wastewater)
- Elf Atochem (3009 Taylor Way) (stormwater commingled with wastewater)
- Elf Atochem (2901 Taylor Way) (stormwater commingled with wastewater)
- General Metals (1902 Marine Way Drive)
- Wasser Winters Log Sort Yard (1602 Marine View Drive)
- Louisiana-Pacific Log Sort Yard (3701 Taylor Way)
- Blair Backup Property (2902 Taylor Way)
- Tacoma Boatbuilding Company, Yard #1 (1840 Marine View Drive)
- Modutech Marine (2218 Marine View Drive)
- Jones-Goodell (1690 Marine View Drive)
- Hylebos Marina (1940 Marine View Drive)
- Nordlund Boat (1622 Marine View Drive)
- USG Interiors (2301 Taylor Way)
- Murray Pacific Log Sort Yard (3502 Lincoln Ave.)
- Don Oline Marine View Drive (2120 Marine View Drive)

Step 2: Identification of Applicable Stormwater Data

Based on the review of available data, seven sites had no post-cleanup stormwater quality data and were excluded from further analysis:

- Wasser Winters
- Louisiana Pacific Log Sort Yard
- Blair Backup Property
- Tacoma Boatbuilding Company
- Jones-Goodell
- Murray Pacific
- Don Oline Marine View Drive

The chemical concentrations for the remaining sites with post-cleanup stormwater data were compiled and are presented in Appendix A. These sites were subject to the screening approach described in Step 3.

Step 3: Derivation of Stormwater Screening Concentrations

Stormwaters carry contaminants in two phases, dissolved in solution and as particulate matter in suspension. In stormwater the concentration of suspended material may be large, and at high flow rates the particulate concentration greatly exceeds the concentrations of dissolved material. The mechanism of chemical loading to sediment depends on the phase of the contaminant.

Chemical loading to sediment from chemicals in the dissolved phase is controlled by sorption processes; whereas loading from suspended material is controlled by the mass flux, which is related to concentration and time.

The reported stormwater data provide only a total (dissolved plus particulate phase) concentration for each constituent measured. Since there is no way of knowing the actual proportion of particulate or dissolved matter represented in the data, this analysis proceeds with two calculations in an attempt to bracket the range of recontamination potential from these sites. Contaminant loading to sediment is first evaluated in Step 3a assuming that the measured concentrations occur entirely as dissolved and then in Step 3b assuming that all contaminants are in the suspended particulate matter phase.

Step 3a: Dissolved Stormwater Chemical Loading to Sediment

In this step, all the contamination present in stormwater is assumed to be in the dissolved phase. Dissolved constituents in stormwater bind to sediment particles primarily by sorption/desorption processes. This screening approach also conservatively assumed that the surface water concentrations in the waterway around the discharge point were equal to the average contaminant concentrations measured in the stormwater (i.e., no dilution of runoff was assumed). The portion of the dissolved mass in surface water contaminants that is retained on sediment is a function of the partitioning coefficient (K_d) and the surface water concentration (C_w). The sediment concentration (C_s) is predicted using the following relationship:

$$C_s = C_w * K_d$$

Where:

C_s = sediment concentration (mg/kg)

C_w = water concentration (mg/L)

K_d = partitioning coefficient (L/kg)

By rearranging the equation, the water concentration for a given sediment concentration and K_d can be calculated using the following relationship:

$$C_w = \frac{C_s}{K_d}$$

The SQOs are the standards by which chemical concentrations in sediment are compared to determine if remediation may be needed. By substituting the SQO concentration for each chemical into this equation, the dissolved phase stormwater concentration that results in a sediment exceedance of its SQO can be calculated. The stormwater concentration for each chemical constituent that results in a sediment exceedance of its SQO is referred to as the stormwater screening concentration (SWSC). Stormwater concentrations exceeding the SWSC indicate a potential for sediment recontamination and that existing source controls may not be sufficient to protect sediment quality. Table 1 shows the partitioning coefficients and resulting SWSCs calculated for the chemicals identified in Step 2.

The relationship used to calculate the SWSC makes several major conservative assumptions. First, the method assumes that chemicals are removed from water by sorption onto the sediment matrix. Second, the methods assumes that the portion of chemical sorbed to the sediment is simply a function of the stormwater concentration and a literature-derived partitioning coefficient. Finally, the entire contaminant load is assumed to be dissolved and the surface water concentrations in the waterway around the discharge point were assumed to be equal to the average contaminant concentrations measured in the stormwater (i.e. no dilution of runoff was assumed).

For this dissolved phase evaluation, if a stormwater concentration is less than the SWSC, the SQO will not be exceeded in sediment; therefore, the chemical will not likely impact sediment quality in the Hylebos Waterway. If the stormwater concentration is equal to or greater than the SWSC, there is a potential for an exceedance of SQO in sediment. Site-specific comparisons to the SWSC are shown in Table 4.

The SWSC were compared to the stormwater quality data to identify sites with exceedances. Benzo(a)pyrene detected at the Kaiser Aluminum outfalls was the only chemical constituent with concentrations that exceeded the SWSC.

Step 3b: Particulate Stormwater Chemical Loading to Sediment

This step evaluates the potential of contaminant mass loading from stormwater to recontaminate sediments over time assuming all contaminants measured in the chemical analysis occur as particulate matter.

Stormwater quality data and stormwater volume estimates were used to calculate the mass of contaminant discharging into the waterway. The contaminant mass was converted to a sediment-loading factor assuming that all of the contaminant mass was retained within an arbitrary sediment volume.

The amount of stormwater discharging into the waterway is a function of volume of rainfall that falls on the site and the percentage of rainfall that leaves the site as runoff. The volume of rainfall was estimated using an approximation of the site area and average annual precipitation for the Tacoma area (37 inches per year). The rainfall volume from each site was estimated using the following relationship:

$$R_p = A_s * P_t$$

Where:

R_p = average rainfall volume by precipitation (m^3)

A_s = site area (m^2)

P_t = average rainfall (m)

The area (in square meters) of each site was estimated from a site map. The amount of precipitation leaving the site as runoff depends on whether or not the site is paved. This is expressed by the runoff coefficient (R_r) in terms of percent. For example, a coefficient 0.95 indicates that 95 percent of precipitation becomes runoff. At all sites except Kaiser and Elf at 3009 Taylor Way, the R_r value is 0.95.

Stormwater runoff from the site was estimated using the following relationship:

$$R_{sw} = R_r * R_p$$

Where:

R_{sw} = volume of stormwater runoff from the site (m^3)

R_r = runoff coefficient

R_p = volume of rainfall falling on site (m^3)

Runoff was equally divided amongst the stormwater outfalls at the site. If there was more than one documented stormwater drain at the site, then it was assumed that each drain carried the same volume of stormwater. The variables and results of stormwater volume calculations above are provided in Table 3.

The potential of a specific chemical in the particulate phase of stormwater to recontaminate sediment was evaluated using a sediment-loading factor. The sediment-loading factor is defined as a measure of the contaminant concentration added per year (mg/kg-yr) to a specified volume or mass of sediment. The loading factor is a sediment concentration that is used to determine the potential for sediment to exceed the applicable sediment quality standards over time.

A sediment-loading factor was calculated using the following relationship:

$$\text{Sediment-loading factor (mg/kg-yr)} = \frac{(C_w R_{sw})/S_v}{P_b}$$

Where:

C_s = average stormwater concentration (mg/L)

R_{sw} = volume of stormwater runoff (m^3)

S_v = receiving sediment volume (m^3)

P_b = sediment bulk density (kg/L)

The following assumptions were used in calculating the sediment-loading factor from stormwater particulate phase.

- The average total chemical concentration in stormwater was used.
- It was assumed that the entire contaminant mass was retained on a volume of sediment having an arbitrary volume of 150 feet long and 150 feet wide and 1 foot thick near the stormwater outfall (sediment volume = 639 m^3).
- Chemical concentrations are evenly distributed throughout the sediment layer.
- The mass loading rate is constant.
- No attenuation of contaminants occurred during transport or in the sediment.
- The sediment bulk density was assumed to be 1.7 kg/L.

The calculated chemical specific sediment-loading factors for each site are presented in Table4. The sediment loading factor was used to calculate a sediment concentration after 10, 20, and 30 years. The predicated sediment concentrations were compared to the SQOs to determine the potential for stormwater to impact sediment. If the sediment concentrations calculated after 30 years were equal or less than the SQOs, then there was considered to be no potential to contaminate sediments. If the sediment concentrations calculated at 30 years exceed the SQOs, the potential to contaminate sediment is assumed to be low. It was assumed that the potential to contaminant sediment was high if sediment concentration exceeded the SQO after 10 or 20 years.

Step 4: Determination of Site-Specific Stormwater Quality Potential to Impact Sediments

The SWSC and stormwater loading factors from Steps 3a and 3b were used to identify sites at risk to recontaminate Hylebos sediments. The following sites were identified to have stormwater chemicals with the potential to impact Hylebos sediments.

- Kaiser Aluminum
- General Metals
- Hylebos Marina
- USG Interiors

3. SOURCES OF UNCERTAINTY

This section presents the major categories of uncertainties associated with the findings of this recontamination analysis. Although this analysis is not without uncertainty, it does present a sufficient level of information to support informed risk management decisions. The following is a list of the assumptions made with brief explanations of the resultant uncertainties that may influence the outcome of this analysis.

- Contamination carried in stormwater is not degraded, dispersed or diffused. The approach selected to estimate stormwater recontamination potential does not include variables for degradation, dispersion, diffusion, dilution and sediment deposition, and assumed they were not significant. To not account for these processes is a conservative assumption since they do occur to some degree and would reduce loading to sediment, thus reducing the potential for sediment recontamination via stormwater.
- The sampling and analysis protocols employed at each site accurately represent the scale and distribution of stormwater contamination. The uncertainty associated with this type of assumption cannot be quantified.
- The loading of dissolved surface water contaminants onto sediment can be represented as a simple linear instantaneous equilibrium sorption reaction. The process by which contamination is retained on the sediment is a function of the partitioning coefficient and the surface water concentration. In environments were sorption between surface water and sediments are not in equilibrium, significant errors in estimating sediment loading resulting from surface water may occur. The assumption that the equilibrium sorption reaction is an instantaneous process is conservative for the purpose of this screening approach.
- Literature values for partitioning coefficients are representative of site conditions. They may, in fact, be more or less conservative than actual conditions. Site-specific adsorption/desorption studies would be necessary to confirm this, but were not conducted.
- Degradation, dilution and sediment deposition are not significant processes with regard to chemical behavior and transport of stormwater contaminants. Not accounting for these processes is a conservative assumption since they do occur. These processes have the potential to reduce the impact of stormwater on sediment recontamination.
- Average stormwater concentrations and intermediate partitioning coefficients were used in calculating stormwater screening concentrations. Although the use of average concentrations and intermediate coefficients is less conservative than using maximum values, maximum values reflect extreme conditions that are not likely representative of typical waterway conditions. The use of average concentrations and partitioning values offsets other conservative assumptions used in this screening approach.

The inputs used to calculate the stormwater screening concentrations are based on conservative assumptions, so that the stormwater screening concentrations is generally biased towards estimating elevated sediment concentrations. Although there are several more complex methods for determining stormwater impacts to sediment, those methods either include additional variables for which site-specific data are unavailable or require additional field sampling and laboratory analysis.

The reliability of the sediment recontamination predictions may be reduced in cases where actual conditions differ significantly from the assumptions used to formulate the conceptual model used for this analysis. The selected approach for evaluating stormwater source control effectiveness is reasonable and, because of the aggregate effect of input assumptions tending to favor recontamination potential, it is useful in identifying sites where stormwater discharges could potentially recontaminate sediments.

4. SITE-SPECIFIC ANALYSIS

Site-specific analysis concerning the potential impact of stormwater on Hylebos sediments is provided below.

4.1 Kaiser Aluminum and Chemical Company (3400 Taylor Way)

Kaiser operated a primary aluminum smelter and wire mill at this location. Kaiser has a National Pollutant Discharge Elimination System (NPDES) permit authorizing discharges of process wastewater from the plant and stormwater from the site. The plant has four discharge points, three of which drain into the Hylebos Waterway. Outfall 001 discharges stormwater and non-contact cooling water; outfalls 003 and 004 discharge only stormwater to Hylebos. Ecology renewed a modified permit, which required Kaiser to monitor the 001, 003 and 004 outfalls. Outfall 001 is monitored for benzo(a)pyrene, polychlorinated biphenyls (PCBs), nickel and copper. Outfalls 003 and 004 are monitored for benzo(a)pyrene. The status of Outfall 002 is not known. Stormwater concentrations were evaluated using monthly average (MA) concentrations for nickel, copper, PCBs and benzo(a)pyrene (Appendix Table A-1).

Based on NPDES-permit-required monitoring, stormwater has not exceeded their effluent limits for monitored chemicals; however, the whole effluent toxicity tests for chronic effect indicated toxicity to *Ceriodaphnia dubia*. Ecology is in the process of renewing Kaiser's permit, which will require an upgraded stormwater treatment system.

Benzo(a)pyrene exceeded the SWSC in all the outfalls except Outfall 001C. The SWSC was not exceeded for PCBs, copper and nickel in Outfall 001C. Sediment loading factors were calculated for benzo(a)pyrene, PCBs, nickel and copper using average stormwater concentrations. The SQOs were not exceeded for any monitored chemicals after 30 years of loading.

There is a low potential for benzo(a)pyrene to impact Hylebos sediment quality from existing stormwater concentrations in Outfalls 003C and 004C.

4.2 Elf Atochem (3009 Taylor Way)

The Elf Atochem 3009 Taylor Way property was used as a log sort yard from 1964 to 1986. Ecology sampled runoff from the site that indicated that it represented a source of arsenic, copper, lead, zinc, antimony, phenol and 4-methylphenol to the head of the Hylebos Waterway. In 1991, Ecology approved a cleanup action plan that included grading the site to divert all surface water runoff to a single discharge point for post-cleanup monitoring of the runoff and monitoring surface water for arsenic, copper, lead and zinc. Three stormwater samples collected in December 1993, November 1995 and March 1997 were analyzed for arsenic, copper, lead and zinc (Appendix Table A-2).

SWSC concentrations were not exceeded for arsenic, copper, lead, and zinc. Sediment loading factors were calculated for arsenic, copper, lead and zinc using the average stormwater concentrations. The SQOs were not exceeded for these chemicals. Based on this analysis, stormwater concentrations of arsenic, copper, lead and zinc at the site will not impact Hylebos sediments.

4.3 Elf Atochem (2901 Taylor Way)

Various inorganic chemicals have been manufactured at the site since the 1928 (Elf Atochem 1996). The main products from the site have been chlorine, sodium hydroxide, hydrochloric acid and sodium chlorate. Currently only sodium chlorate and by-product hydrogen are produced at the site. The facility has operated under an NPDES permit since 1985. The plant discharges approximately 9 million gallons of industrial wastewater each day. The water is primarily marine/non-contact cooling water obtained from the Hylebos Waterway combined with smaller quantities of fresh water, remediation-derived water, treated washwater and stormwater. There is one outfall, Outfall 001, that discharges to the Hylebos Waterway. Plant wastewater and stormwater are discharged through Outfall 001. The discharge of once-through non-contract cooling water is continuous but flows increase when stormwater is present. Outfall 001 also receives a small volume of treated water from the on-site groundwater remediation processes which enter the general wastewater system designated as Internal Discharge Point (IDP) 002 for the arsenic treatment system effluent, and IDP 004 for the VOC treatment system effluent.

The effluent from Outfall 001 is being monitored for total antimony, total arsenic and total chromium. Average monthly concentrations for these metals measured between December 1995 and June 1998 were analyzed (Appendix Table A-3). Antimony was either not detected or not analyzed during this period.

The SWSC concentration was not exceeded using average arsenic or chromium concentrations. Sediment loading factor was calculated for arsenic and chromium using the average stormwater concentration. The SQOs were not exceeded for arsenic and chromium.

There appears to be no potential for stormwater arsenic and chromium concentrations to impact Hylebos sediment quality.

4.4 General Metals (1902 Marine Way Drive)

The site has been used for recycling metals and as a log yard. Concentrations of total copper, lead, zinc, and PCBs in surface runoff averaged about 3 orders of magnitude higher than chronic water quality criteria. Ecology approved a cleanup plan in 1991, which included the installation of a drainage system to collect stormwater from the process areas to be capped. Ecology issued an NPDES permit for discharge of treated stormwater. In 1990, General Metals installed a stormwater treatment system with a design capacity of 200 gallons per minute. By 1996, the entire site was capped with a low-permeability asphalt and large aggregate industrial surface. The stormwater from the capped area is being collected and treated in the stormwater treatment system before discharge into the Hylebos Waterway.

Treated stormwater has been monitored for copper, zinc, lead, and PCBs. Average stormwater concentrations for copper, zinc, lead and PCBs were calculated from stormwater data collected between December 1995 and June 1998 (Appendix Table A-4). PCBs were essentially not detected in stormwater and therefore no further analysis of PCBs was conducted for this memorandum.

SWSCs were not exceeded for copper, zinc and lead. Sediment loading factors were calculated for copper, lead and zinc using average stormwater concentrations. The SQO was exceeded for zinc but not those for copper or lead.

There appears to be no potential for stormwater concentrations of copper and lead to impact Hylebos sediments. There appears to be a low potential for zinc to impact Hylebos sediment quality.

4.5 Wasser Winter (1602 Marine View Drive)

The site is a vacant log sort yard owned by the Port of Tacoma. Slag from the Asarco smelter was placed on the site. Elevated concentrations of arsenic, copper, lead and zinc were detected in stormwater in the early 1980s. Ecology developed a cleanup plan requiring the Port of Tacoma to remediate the site. The remediation plan, which was completed in 1993, included paving the site, installing a stormwater system, and monitoring surface water for arsenic, copper, lead, and zinc. No post cleanup stormwater monitoring has been conducted.

4.6 Louisiana-Pacific Log Sort Yard (3701 Taylor Way)

Louisiana Pacific (LP) currently operates a log sort yard adjacent to its Tacoma lumber mill. Ecology sampled runoff from the log sort yard in 1980s and detected high concentrations of arsenic, copper, lead, and zinc. In 1987, LP detected elevated levels of arsenic, copper, lead, and zinc in surface water runoff. Ecology approved a cleanup plan for the site which included capping of the entire log yard with concrete to prevent infiltration of stormwater and constructing a stormwater collection system. No stormwater monitoring has been required at the site.

4.7 Blair Backup Property (2902 Taylor Way)

Stormwater runoff from this 17-acre portion of the Blair Backup Property discharges to Hylebos Waterway via Kaiser Ditch. No stormwater monitoring is required or planned at the site; therefore, no data were available.

4.8 Tacoma Boatbuilding Company Yard #1 (1840 Marine View Drive)

Based on samples collected in 1991, concentrations of metals above the ambient water quality criteria were detected in stormwater for copper, lead, and zinc. Tacoma Boatbuilding was in bankruptcy in 1997 and the NPDES permit was terminated. Cleanup activities, including changes in the stormwater system, are planned by a new owner. No post-cleanup analysis of stormwater has been required at the site.

4.9 Modutech Marine (2218 Marine View Drive)

Modutech Marine is a boat construction and repair facility that has operated since 1983. Before 1993, washwater from boat hull hydroblasting discharged to the Hylebos Waterway. The site is paved. Stormwater from the north portion of the site enters the Hylebos Waterway through a swale that discharges into the Hylebos Waterway.

Modutech is covered under the general NPDES stormwater permit for small boatyards. The permit required Modutech to conduct monitoring of oil and grease, total suspended solids, and copper in stormwater. The permit contains no effluent limits. Modutech ceased discharge of pressure wash wastewater to the Hylebos Waterway in March 1993.

Eight stormwater samples were analyzed for total recoverable copper between 1996 through 1998 (Appendix Table A-5). Concentrations of copper ranged from 37 to 270 µg/L, with an average of 242 µg/L.

The SWSC concentration was not exceeded for copper. A sediment loading factor was calculated for copper. The SQO was not exceeded for copper based on use of an average concentration. There appears to be no potential for copper stormwater concentrations to impact Hylebos sediment quality.

4.10 Jones-Goodell (1690 Marine View Drive)

No stormwater data are available for the site. The site is undergoing redevelopment. Hyland Marine has applied to Ecology for coverage under the General Boatyard Permit. The applications include plans to construct a washwater recycling system and a stormwater sand filtration trench between the work area and the waterway.

4.11 Hylebos Marina (1940 Marine View Drive)

Hylebos Marina is a boat repair yard that has operated since the mid-1960s. Site stormwater is discharged to Hylebos Waterway through a ditch at the northwest end of the gravel yard and through a series of catch basins and an outfall in the parking area near the office. In 1995 the site owners received a shoreline permit for site improvements including paving of the gravel yard, upgrading the storm drainage system, and installing stormwater filtration swales.

Hylebos Marina is covered under the general NPDES stormwater permit for small boatyards. The permit required Hylebos Marina to conduct monitoring of oil and grease, total suspended solids, and copper in stormwater. The permit contains no effluent limits. Hylebos Marina ceased discharge of pressure wash wastewater to the Hylebos Waterway in 1993.

Stormwater sampling was conducted twice in 1996 and again in 1998 (Appendix Table A-6). Stormwater copper concentrations ranged from 259 to 2,100 µg/L (mean = 1,022 µg/L).

The SWSC concentration was not exceeded for average copper concentrations. A sediment loading factor was calculated for copper using the average stormwater concentration. The SQO was exceeded for copper.

There appears to be a moderate potential for stormwater copper concentrations to impact Hylebos sediment quality.

4.12 Nordlund Boat (1622 Marine View Drive)

Nordlund has operated a fiberglass boat construction business since 1988. The site is paved and stormwater is routed to a detention basin, which drains to Hylebos Waterway. Two stormwater drains are present.

Nordlund is covered under the general NPDES stormwater permit for small boatyards. The NPDES permit required to conduct monitoring of oil and grease, total suspended solids (TSS), and copper in stormwater. No effluent limits were provided. Nordlund ceased discharge of pressure wash wastewater to the Hylebos Waterway in June 1995.

Five stormwater samples were obtained in 1997 and 1998. Three stormwater samples were collected from the south drain and two samples from the north drain. The samples were analyzed for total recoverable copper. Copper concentrations ranged from 30 to 720 µg/L.

The SWSC concentration for copper was not exceeded. Sediment loading factor for the north and south drains were calculated using the average stormwater copper concentration. The SQO was not exceeded for copper for either drain.

There appears to be a no potential for stormwater copper concentrations to impact Hylebos sediment quality.

4.13 USG Interiors (2301 Taylor Way)

USG Interiors has manufactured rock wool at the site since 1959. USG Interiors is located on 9.4 acres and drains to one stormwater outfall. Ecology collected a stormwater sample in 1992. Arsenic, copper, lead, nickel, zinc, antimony, and mercury were detected in the stormwater sample. Stormwater metal concentrations were lower than during the Phase I testing, but it was not clear whether this was due to the stormwater drain cleaning or variations due to wet/dry weather sampling.

USG continued stormwater monitoring at the outfall in 1994 and 1995. Concentrations of arsenic ranged from 340 to 1,000 μg/L. Four samples collected in 1996 had the concentrations of up to 1,000 μg/L of arsenic. In September 1998 the site was paved. The storm drain lines were replaced in the fall of 1998. Stormwater was sampled for antimony, arsenic, chromium, copper, lead, and zinc. Only arsenic and zinc concentrations were detected.

The SWSC concentrations for arsenic and zinc were not exceeded. Sediments loading factors were calculated for arsenic and zinc. The SQO was exceeded for arsenic but not for zinc. There appears to be a moderate potential for stormwater zinc concentrations to impact Hylebos sediment quality.

4.14 Murray Pacific Log Sort Yard #1 (3502 Lincoln Avenue)

Before site cleanup activities were completed, rainfall drained to ponds on the site and to a ditch in the southwest portion of the property. This ditch connected to Hylebos Waterway via an 18-inch storm drain line. Stormwater in the ditch contained high concentrations of arsenic. Total concentrations of arsenic ranged from 560 to 29,000 μg/L. Cleanup activities were conducted at the site in 1996. All soils with arsenic contamination above MTCA residential cleanup levels were removed. No post cleanup stormwater data is available.

4.15 Don Oline Marine View Drive Autofluff (2120 Marine View Drive)

Soils with contamination above SQO levels were removed in 1997. No stormwater sampling has been conducted at the site.

5. CONCLUSIONS

Stormwater has been identified as a potentially significant pathway for recontamination of sediments in the head of the Hylebos Waterway. Eight sites with stormwater data were evaluated for the potential for stormwater to impact sediments in head of the Hylebos Waterway. Stormwater data were not available for eight sites.

The evaluation approach consisted of estimating a sediment loading factor for contaminants to a hypothetical mass of sediment next to the stormwater outfall and developing a SWSC. The resulting concentrations in sediment were compared to the SQOs to evaluate whether stormwater quality had a potential to impact sediment in the waterway.

Three sites had calculated stormwater loadings with a potential to impact sediments. Benzo(a)pyrene was identified at Kaiser Aluminum with a low potential to recontaminate sediments. Zinc has a low potential to recontaminate sediments at the General Metals site and copper has a moderate potential to recontaminate sediments at the Hylebos Marina site. Arsenic has a moderate potential to recontaminate sediment at the USG Interiors site.

6. REFERENCES

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TABLES

Table 1—Determination of Stormwater Screening Concentrations

Chemical	SQO (mg/kg)	Partitioning Coefficient (L/kg)	SWSC (mg/L)
Antimony	150	10	15.0
Arsenic	57	76	0.75
Chromium	57	190	0.3
Copper	390	79	4.9
Lead	450	1200	0.38
Nickel	140	365	0.38
Zinc	410	147	2.79
Benzo(a)pyrene	1.6	300	0.005
PCBs	0.3	300	0.001

Notes:

SQO from Commencement Bay sediment quality objectives (EPA 1989, 1997).

Kd - Chemical-specific partitioning coefficient

SWSC - Stormwater screening concentration based on Kd (SQO/Kd)

Table 2—Summary of Stormwater Potential to Impact Sediments Analysis
Hylebos Waterway

Step 1		Step 2			Step 3a[1]		Step 3b[2]	Step 4[3]
		Statistical Summary						
Site Name & Address		Stormwater Data	Chemical	Arith. Mean (µg/L)	SWSC (µg/L)	Exceed SWSC?	Potential to Exceed SQO?	Potential to Recom Sediment
Kaiser Aluminum	Outfall 001C	Yes	Benzo(a)pyrene	1.1	5	No	No	No
3400 Taylor Way			PCBs	0.11	1	No	No	No
			Copper	11.3	4900	No	No	No
			Nickel	8.6	380	No	No	No
	Outfall 003C		Benzo(a)pyrene	8.4	5	**Yes**	No	**Low**
	Outfall 004C		Benzo(a)pyrene	2.1	5	**Yes**	No	**Low**
Elf Atochem		Yes	Arsenic	18	750	No	No	No
3009 Taylor Way			Copper	36	4900	No	No	No
			Lead	4.33	380	No	No	No
			Zinc	37	2790	No	No	No
Elf Atochem		Yes	Arsenic	13.8	750	No	No	No
2901 Taylor Way	Outfall 001		Chromium	4.2	300	No	No	No
General Metals		Yes	Copper	30	4900	No	No	No
1902 Marine Way Dr.			Lead	90	380	No	No	No
			Zinc	160	2790	No	**Yes**	**Low**
Wasser Winters 1602 Marine View Dr.		No						
Louisiana-Pacific 3701 Taylor Way		No						
Blair Backup Property 2902 Taylor Way		No						
Tacoma Boatbuilding 1840 Marine View Dr.		No						
Jones-Goodell 1690 Marine View Dr.		No						
Modutech Marine 2218 Marine View Dr.		Yes	Copper	242	4900	No	No	No
Hylebos Marina 1940 Marine View Dr.		Yes	Copper	1022	4900	No	**Yes**	**Moderate**
Nordlund Boat	North Drain	Yes	Copper	363	4900	No	No	No
1622 Marine View Dr.	South Drain	Yes	Copper	45	4900	No	No	No
USG Interiors		Yes	Arsenic	70	750	No	**Yes**	**Moderate**
2301 Taylor Way			Zinc	82	2790	No	No	No
Murray Pacific 3502 Lincoln Ave.		No						
Don Oline Marine View 2120 Marine View Dr.		No						

[1] Based on the assumption that contamination is in dissolved phase of stormwater.

[2] Based on the assumption that contamination is in particulate phase of stormwater.

[3] Based on the assumption that load is constant from particulate phase over periods of 10, 20, 30 years.

Table 3—Summary of Stormwater Volume Estimates

Site Name	Site Area (m^2)	Average Annual Precipitation (m)	Annual Rainfall Volume (m^3)	Runoff Coefficient	Annual Stormwater Volume (m^3)	Number Storm Drains	Runoff Volume per drain (m^3/yr)
Kaiser Aluminum	116,385	0.940	109,367	0.05	5,468	4	1,367
Elf Atochem 3009	90,968	0.940	85,483	0.19	16,242	1	16,242
Elf Atochem 2901	163,040	0.940	153,209	0.95	145,548	1	145,548
General Metals	128,425	0.940	120,681	0.95	114,647	1	114,647
Modutech	13,378	0.940	12,571	0.95	11,942	1	11,942
Hylebos Marina	24,581	0.940	23,099	0.95	21,944	1	21,944
Nordlund Boat	24,080	0.940	22,628	0.95	21,496	2	10,748
USG Interiors	48,964	0.940	51,541	0.95	48,960	1	48,960

Notes:

Runoff coefficient of 0.95 was used assuming the site is paved and little infiltration of precipitation occurs.

Average rainfall for Tacoma is 37 inches (0.94 meter) per year.

Table 4—Summary of Sediment Loading Factors

Site Name		Chemical	Average Stormwater Concentration (µg/L)	Annual Storm Water Volume (m3/yr)	Chemical Mass Loading Rate (mg/yr)	Sediment Volume (Cubic Meters)	Sediment Load Factor (mg/kg-yr)	Sediment Mass Loading x 10yrs (mg/kg)	Sediment Mass Loading x 20yrs (mg/kg)	Sediment Mass Loading x 30yrs (mg/kg)	SQO (mg/kg)
Kaiser	Outfall 001C	Benzo(a)pyrene	1.1	1,367	1,504	639	0.001	0.01	0.03	0.04	1.6
Aluminum		PCBs	0.11	1,367	150	639	0.0001	0.001	0.003	0.004	0.3
		Nickel	8.6	1,367	11,756	639	0.01	0.1	0.2	0.3	140
		Copper	11.3	1,367	15,447	639	0.01	0.1	0.3	0.4	390
	Outfall 003C	Benzo(a)pyrene	8.4	1,367	11,483	639	0.01	0.1	0.2	0.3	1.6
	Outfall 004C	Benzo(a)pyrene	2.1	1,367	2,871	639	0.003	0.03	0.05	0.08	1.6
Elf Atochem		Arsenic	18	16,242	292,356	639	0.27	3	5	8	57
3009 Taylor		Copper	36	16,242	584,712	639	0.54	5	11	16	390
		Lead	5.3	16,242	86,083	639	0.08	1	2	2	450
		Zinc	37	16,242	600,954	639	0.55	6	11	17	440
Elf Atochem		Arsenic	13.8	145548	2,008,566	639	1.8	18	37	55	57
2901 Taylor	Outfall 001C	Chromium	4.2	145,548	611,303	639	0.6	6	11	17	57
General Metals		Copper	30	114,647	3,439,418	639	3.2	32	63	95	390
		Lead	90	114,647	10,318,254	639	9.5	95	190	285	450
		Zinc	160	114,647	18,343,562	639	16.9	169	338	507	440
Modutech		Copper	242	11,942	2,890,066	639	2.7	27	53	80	390
Hylebos Marina		Copper	1022	21,944	22,426,975	639	20.6	206	413	619	390
Nordlund Boat	North Drain	Copper	363	10,748	3,901,590	639	3.6	36	72	108	390
	South Drain	Copper	45	10,748	483,668	639	0.4	4	9	13	390
USG Interiors		Arsenic	70	48,960	3,427,200	639	3.2	32	63	95	57
		Zinc	82	48,960	4,014,720	639	3.7	37	74	111	440

Notes:

Annual stormwater volume from Table 3.

Chemical mass loading rate derived from average stormwater concentration (mg/L) annual stormwater volume (m3/year).

Sediment-loading factor calculated from following relationship [(Cw * Rsw)/Sv]/Pb where Cw is average stormwater concentration (mg/L); Rsw is annual stormwater runoff (m3/year); Sv is sediment volume (m3); Pb is sediment bulk density (kg/L).

SQO is Commencement Bay sediment quality objectives (EPA 1989, 1997).

APPENDIX A

STORMWATER DATA

Table A-1—Summary of Kaiser Aluminum (3400 Taylor Way) Stormwater Chemical Data

Sampling Date	Outfall 001C								Outfall 003C		Outfall 004C	
	Benzo[a] pyrene MA mg/L	PCBs total mg/L	Nickel t.r. MA mg/L	Nickel t.r. DM mg/L	Copper diss. MA mg/L	Copper diss. DM mg/L	Copper t.r. MA mg/L	Copper t.r. DM mg/L	Benzo[a] pyrene MA mg/L	Benzo(a) pyrene MM mg/L	Benzo(a) pyrene MA mg/L	Benzo(a) pyrene MM mg/L
Jan-96	0.0018	0.0001 U	--	--	--	--	--	--	0.005	--	--	0.001 U
Feb-96	0.004	0.0001 U	--	--	--	--	--	--	0.009	0.023	--	0.0007
Mar-96	0.001 U	0.0001 U	--	--	--	--	--	--	0.001 U	--	--	0.001 U
Apr-96	0.001 U	0.0001 U	--	--	--	--	--	--	0.001 U	--	--	0.001 U
May-96	0.001 U	0.0001 U	--	--	--	--	--	--	0.035	--	--	0.001 U
Jun-96	0.001 U	0.0001 U	--	--	--	--	--	--	--	--	--	--
Jul-96	0.001 U	0.00015	--	--	--	--	--	--	--	--	--	--
Aug-96	0.001 U	0.0001 U	--	--	--	--	--	--	--	--	--	--
Sep-96	0.001 U	0.0001 U	--	--	--	--	--	--	--	--	--	--
Oct-96	0.001 U	0.0001 U	--	--	--	--	--	--	--	0.001	--	0.001 U
Nov-96	0.001	0.0001 U	--	--	--	--	--	--	0.005	0.012	--	0.001 U
Dec-96	0.001	0.0001 U	--	--	--	--	--	--	0.006	0.006	--	0.001 U
Jan-97	0.001 U	0.0001 U	0.009	0.012	0.005	0.008	0.01	0.011	0.0008	0.001	0.007	0.001
Feb-97	0.002	0.0001 U	0.006	0.009	0.004	0.004	0.004	0.009	0.003	0.005	0.003	--
Mar-97	0.002	0.0001 U	0.01	0.014	0.006	0.009	0.01	0.017	--	0.002	--	0.001 U
Apr-97	0.001 U	0.0003	0.005	0.009	0.005	0.005	0.006	0.009	--	0.005	--	0.001 U
May-97	0.001 U	0.0001 U	0.003	0.003	0.003	0.004	0.004	0.004	0.001 U	--	0.001	--
Jun-97	0.001 U	0.0001 U	0.005	0.01	0.005	0.007	0.005	0.009	0.001	--	0.001 U	--
Jul-97	0.001 U	0.0001 U	0.003	0.004	0.002	0.004	0.003	0.004	0.001	--	0.001 U	--
Aug-97	0.001 U	0.0001 U	0.009	0.003	0.002	0.002	0.003	0.003	0.002	--	0.001	--
Sep-97	0.001 U	0.0001 U	0.004	0.007	0.003	0.003	0.003	0.005	--	--	--	--
Oct-97	0.001 U	0.0001 U	0.004	0.007	0.003	0.005	0.005	0.01	0.007	0.013	0.001	--
Nov-97	0.001 U	0.0001 U	0.005	0.013	0.004	0.006	0.009	0.014	0.002	--	--	0.001
Dec-97	0.001 U	0.0001 U	0.006	0.007	0.003	0.003	0.006	0.007	0.001 U	--	--	0.002
Jan-98	0.003	0.0001 U	0.016	0.018	0.004	0.006	0.019	0.025	0.012	0.017	--	0.001
Feb-98	0.001	0.0001 U	0.007	0.009	--	--	0.006	0.008	0.001	--	--	0.001 U
Mar-98	0.0008	0.0001 U	0.009	0.011	0.008	0.012	0.015	0.024	0.0097	--	--	0.0021
Apr-98	0.0003	0.0001 U	0.004	0.007	0.003	0.004	0.005	0.006	--	0.007	--	0.001
May-98	0.0014	0.0001 U	0.006	0.01	0.004	0.005	0.007	0.009	0.0004	--	--	0.001
Jun-98	0.0001 U	0.0001 U	0.005	0.008	0.004	0.006	0.004	0.009	0.0001	--	--	--
Jul-98	0.0001 U	0.0001 U	0.004	0.005	0.004	0.005	0.004	0.04	--	--	--	--
Aug-98	0.0001 U	0.0001 U	0.003	0.005	0.002	0.002	0.002	0.002	--	--	--	--

Table A-1—Summary of Kaiser Aluminum (3400 Taylor Way) Stormwater Chemical Data

Sampling Date	Outfall 001C Benzo[a] pyrene MA mg/L	Outfall 001C PCBs total mg/L	Outfall 001C Nickel t.r. MA mg/L	Outfall 001C Nickel t.r. DM mg/L	Outfall 001C Copper diss. MA mg/L	Outfall 001C Copper diss. DM mg/L	Outfall 001C Copper t.r. MA mg/L	Outfall 001C Copper t.r. DM mg/L	Outfall 003C Benzo[a] pyrene MA mg/L	Outfall 003C Benzo(a) pyrene MM mg/L	Outfall 004C Benzo(a) pyrene MA mg/L	Outfall 004C Benzo(a) pyrene MM mg/L
Statistical Summary												
Number	32	32	20	20	19	19	20	20	21	11	7	18
Min	0.0001	0.0001	0.0030	0.0030	0.0020	0.0020	0.0020	0.0020	0.0001	0.0010	0.0010	0.0007
Max	0.004	0.0003	0.0160	0.0180	0.0080	0.0120	0.0190	0.0400	0.0350	0.0230	0.0070	0.0021
Mean	0.0011	0.0001	0.0062	0.0086	0.0039	0.0053	0.0065	0.0113	0.0050	0.0084	0.0021	0.0011
Geomean	0.0009	0.0001	0.0055	0.0077	0.0036	0.0048	0.0055	0.0087	0.0022	0.0055	0.0015	0.0011
Median	0.0010	0.0001	0.0050	0.0085	0.0040	0.0050	0.0050	0.0090	0.0020	0.0060	0.0010	0.0010

Notes:

Values provided came from an Ecology data summary, not from any report(s) or data submittals reviewed by EPA or WESTON

U - "not detected"

MA - monthly average

DM - daily mean

MM - monthly mean

mg/L - milligrams per liter

diss. - dissolved

t.r. - total recoverable

Statistical summary assumes that not detected samples are assigned the detection limit value.

"--" not analyzed

Table A-2—Summary of Elf Atochem (3009 Taylor Way) Stormwater Chemical Data

Sample Date	Arsenic (ppb)	Copper (ppb)	Lead (ppb)	Zinc (ppb)
12/9/1993	16	58	13	41
11/10/1995	17	25 U	2 U	50
3/19/1997	22	25 U	1 U	20 U
Statistical Summary				
Number	3	3	3	3
Min	16	25	1	20
Max	22	58	13	50
Mean	18.3	36.0	5.3	37
Geomean	18.2	33.1	3.0	34.5
Median	17.0	25.0	2.0	41.0

Notes:

Values provided came from an Ecology data summary, not from any report(s) or data submittals reviewed by EPA or WESTON.

U - "not detected"

ppb - parts per billion

Statistical summary assumes that not detected samples are assigned the detection limit value.

Table A-3—Summary of Elf Atochem (2901 Taylor Way) Stormwater Chemical and Flow Data

Monitoring Point	Sample Date	Total Arsenic (µg/L)		Total Chromium (µg/L)		Flow (mgd)	
		AVM	MXD	AVM	MXD	AVM	MXD
001	3/1/1998	6	19	U	U	0.08	0.08
001	4/1/1998	0.008	0.08	U	0.02	0.04	0.3
001	5/1/1998	6 U	6 U	4	4	0.01	0.048
001	8/1/1998	6 U	6 U	0.017	5	0.01	0.3
001	10/1/1998	--	--	5	5	--	--
001	11/1/1998	0.01	54	0.16	0.9	0.12	0.5
001	12/1/1998	37	80	1.37	8.2	0.1	0.5
001	1/1/1999	30	60	10.6	17	0.1	0.5
001	2/1/1999	0.006	0.054	8	13	0.1	0.5
001	3/1/1999	50	90	8	10	0.1	0.5
001	4/1/1999	2.8	50	0.4	7	0.03	0.5
Statistical Summary							
Number		10	10	9	10	10	10
Min		0.006	0.054	0.017	0.02	0.01	0.048
Max		50	90	10.6	17	0.12	0.5
Mean		13.8	36.5	4.2	7.0	0.1	0.4
Geomean		1.3	9.0	1.4	3.4	0.1	0.3
Median		6.0	34.5	4.0	6.0	0.1	0.5

Notes:

Values provided came from an Ecology data summary, not from any report(s) or data submittals reviewed by EPA or WESTON.

U - "not detected"

AVM - average monthly concentration

MXD - maximum daily concentration

MAX - maximum concentrations

µg/L - micrograms per liter

mgd - million gallons per day

Detection limits not provided for total chromium.

Samples at the detection limit excluded from statistical analysis.

Statistical summary assumes that not detected samples are assigned the detection limit value.

"--" - not analyzed

Table A-4—Summary of General Metals Stormwater Chemical Data

Sample Date	Copper		Lead		Zinc		PCBs		Flow
	AVM (mg/L)	MXD (mg/L)	AVM (mg/L)	MXD (mg/L)	AVM (mg/L)	MXD (mg/L)	AVM (mg/L)	MXD (mg/L)	(gal/month)
12/1/1995	0.015	0.03	0.05	0.05	0.095	0.11	5		288000
1/1/1996	0.025	0.025	0.05	0.05	0.13	0.18	U	U	280800
3/1/1996	0.025	0.025	0.05	0.05	0.2	0.24	U	U	280800
4/1/1996	0.016	0.031	0.05	0.05	0.22	0.23	U	U	280800
5/1/1996	0.025	0.025	0.05	0.05	0.105	0.16	U	U	273600
6/1/1996	0.025	0.025	0.05	0.05	0.17	0.17	U	U	194300
7/1/1996	0.029	0.029	0.06	0.06	0.12	0.12	U	U	100160
8/1/1996	0.09	0.18	0.05	0.05	0.05	0.1	U	U	133580
9/1/1996	0.025	0.025	0.05	0.05	0.1	0.12	U	U	155160
10/1/1996	0.019	0.038	0.03	0.06	0.135	0.16	U	U	278850
11/1/1996	0.056	0.081	0.05	0.05	0.11	0.13	U	U	280000
12/1/1996	0.02	0.02	0.05	0.05	0.12	0.12	U	U	288000
1/1/1997	0.008	0.028	0.05	0.05	0.103	0.14	U	U	288000
2/1/1997	0.03	0.03	0.05	0.05	0.13	0.13	U	U	288000
3/1/1997	0.028	0.032	0.25	0.37	0.115	0.12	U	U	288000
4/1/1997	0.02	0.039	0.05	0.05	0.135	0.17	U	U	280800
5/1/1997	0.052	0.056	0.05	0.05	0.13	0.14	U	U	216600
6/1/1997	0.025	0.049	0.03	0.059	0.155	0.22	U	U	280800
7/1/1997	0.02	0.02	0.03	0.059	0.165	0.22	U	U	196400
8/1/1997	0.02	0.02	0.15	0.15	0.33	0.33	U	U	79540
9/1/1997	0.02	0.02	0.15	0.15	0.17	0.17	U	U	210900
10/1/1997	0.02	0.02	0.15	0.15	0.064	0.072	U	U	280800
11/1/1997	0.07	0.07	0.15	0.15	0.1	0.1	U	U	280000
1/1/1998	0.016	0.032	0.15	0.15	0.125	0.14	U	U	280600
2/1/1998	0.013	0.025	0.15	0.15	0.275	0.32	U	U	280000
3/1/1998	0.02	0.02	0.15	0.15	0.175	0.15	U	U	280000
4/1/1998	0.02	0.02	0.15	0.15	0.18	0.18	U	U	128710
5/1/1998	0.02	0.02	0.15	0.15	0.175	0.022	U	U	95696
6/1/1998	0.031	0.061	0.105	0.21	0.65	1.3	U	0.001	85244
Statistical Summary									
Number	29	29	29	29	29	29	–	–	29
Min	0.008	0.02	0.03	0.05	0.05	0.022	–	–	79540
Max	0.09	0.18	0.25	0.37	0.65	1.3	–	–	288000
Average	0.03	0.04	0.09	0.10	0.16	0.20	–	–	230143
Geomean	0.02	0.03	0.07	0.08	0.14	0.16	–	–	214083
Median	0.02	0.028	0.05	0.059	0.13	0.15	–	–	280000

Notes:

Values provided came from an Ecology data summary, not from any report(s) or data submittals reviewed by EPA or WESTON.

U - "not detected"

AVM - monthly average

MXD - daily mean

mg/L - milligrams per liter

Detection limits not provided for PCBs.

Statistical summary assumes that not detected samples are assigned the detection limit value.

"–" not analyzed

Table A-5—Summary of Modutech Marine Stormwater Chemical Data

Sample Date	Copper (ppb)
10/07/96	37
11/12/96	590
01/14/97	720
01/21/97	200
10/14/97	100
05/15/98	48
06/10/98	62
09/18/98	180
Statistical Summary	
Number	8
Min	37
Max	720
Average	242
Geomean	142
Median	140

Notes:

Values provided came from an Ecology data summary, not from any report(s) or data submittals reviewed by EPA or WESTON.

ppb - parts per billion

Table A-6—Summary of Hylebos Marina Stormwater Chemical Data

Sample Date	Copper (ppb)
10/18/1996	920
12/5/1996	259
5/14/1998	2100
6/24/1998	810
Statistical Summary	
Number	4
Min	259
Max	2100
Average	1022
Geomean	798
Median	865

Notes:

Values provided came from an Ecology data summary, not from any report(s) or data submittals reviewed by EPA or WESTON.

ppb - parts per billion

Table A-7—Summary of Nordlund Boat Stormwater Chemical Data

Sample Date	Copper (ppb)	
	South Drain	North Drain
10/3/1997	120	--
5/14/1998	250	--
5/14/1998	--	30
7/15/1998	720	--
7/15/1998	--	60
Statistical Summary		
Number	3	2
Min	120	30
Max	720	60
Average	363	45
Geomean	278	42
Median	250	45

Notes:

Values provided came from an Ecology data summary, not from any report(s) or data submittals reviewed by EPA or WESTON.

ppb - parts per billion

"--" not analyzed

Table A-8—Summary of USG Interiors Stormwater Chemical Data

Sample Date	Antimony (mg/L)	Arsenic (mg/L)	Chromium (mg/L)	Copper (mg/L)	Lead (mg/L)	Zinc (mg/L)
4/16/1999	0.05 U	0.06	0.01 U	0.01 U	0.004 U	0.15
5/4/1999	0.05 U	0.087	0.01 U	0.01 U	0.003 U	0.015
Statistical Summary						
Number	2	2	2	2	2	2
Min	0.05 U	0.06	0.01 U	0.01 U	0.003 U	0.015
Max	0.05 U	0.087	0.01 U	0.01 U	0.004 U	0.150
Mean	0.05 U	0.07	0.01 U	0.01 U	0.004 U	0.0825
Geomean		0.07				0.047
Median		0.07				0.083

Notes:

Values provided came from an Ecology data summary, not from any report(s) or data submittals reviewed by EPA or WESTON.

U - "not detected"

mg/L - milligrams per liter

Statistical summary assumes that not detected samples are assigned the detection limit value.